Space Weather Technical Forecast

Issued on Friday, 06 September 2024 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares likely, very slight chance of X-flares. Chance of G1/Minor Geomagnetic Storm conditions on Day 2 and 3 (07 and 08 Sep). Increasing chance of S1/Minor Radiation Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Moderate, with a peak M1.3 flare observed at 09/1325 UTC from AR3807. There are currently nine sunspot regions on the visible disc. AR3807 has now reached the southwest limb, but remained active with numerous C-class flares and an isolated low-level M-flare observed. AR3813 in the southeast demonstrated some slow development in its minor spots, with a small delta spot possibly in its formative stages. AR3806 and AR3611, both moderately sized regions, support Beta-Gamma-Delta classifications, though the delta spots appear small and weak at this time. The remaining sunspot groups on the disc are smaller and more magnetically simple. None of the nine regions showed significant growth or decay during the period.

No Earth-directed CMEs were observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind as measured by ACE and DSCOVR at L1 varied between slow-ambient and slightly elevated levels, generally between 350-400km/s. Density was average or slightly below average. The Interplanetary Magnetic Field, Bt, was predominantly Weak (generally 5-7nT), but increased to Moderate levels from 06/1103 UTC (peak 9nT). The north-south component, Bz, varied weakly and was predominantly northward (+Bz) directed. Phi angle was almost exclusively negative (towards the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 has continued to slowly decline following the response to the M5.5 flare on 01 Sep. It remains above normal background levels, but is well below the S1/Minor Storm threshold. High energy electron flux (greater than 2MeV) observed at GOES16 was at background to moderate levels, peaking at 257 pfu at 05/1650 UTC. The corresponding 24-hour fluence showed a falling then steady trend well below the Active threshold, with 3.62e6 integrated pfu observed at 06/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is likely, with a very slight chance of isolated X-class (Strong) flares. The risk decreases slightly by Day 3 (08 Sep) as AR3807 rotates well over the west limb.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the current forecast. A weak high-speed stream associated with CH65/+ in the northern hemisphere may bring slightly elevated wind speeds on Day 2 and 3 (07 and 08 Sep). Otherwise background wind speeds are expected.

Geomagnetic activity is forecast to be largely Quiet, but expected to reach Unsettled to Active levels with a chance of peak G1/Minor Storm (Kp 5) conditions on Day 2 (07 Sep). Activity should subside to largely Quiet to Unsettled levels again by Day 3 (08 Sep), but with a chance of

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isolated Active intervals.

Energetic Particles / Solar Radiation: High energy proton flux is above background levels, but well below the S1/Minor Radiation Storm threshold. There is a slight chance of exceeding S1 levels in the coming days, increasing to a chance on Day 4 (09 Sep). High energy electron flux is expected to remain at background to moderate levels, perhaps rising late in the period following any HSS effects. There is a slight chance of fluence reaching the Active threshold by the end of the period.

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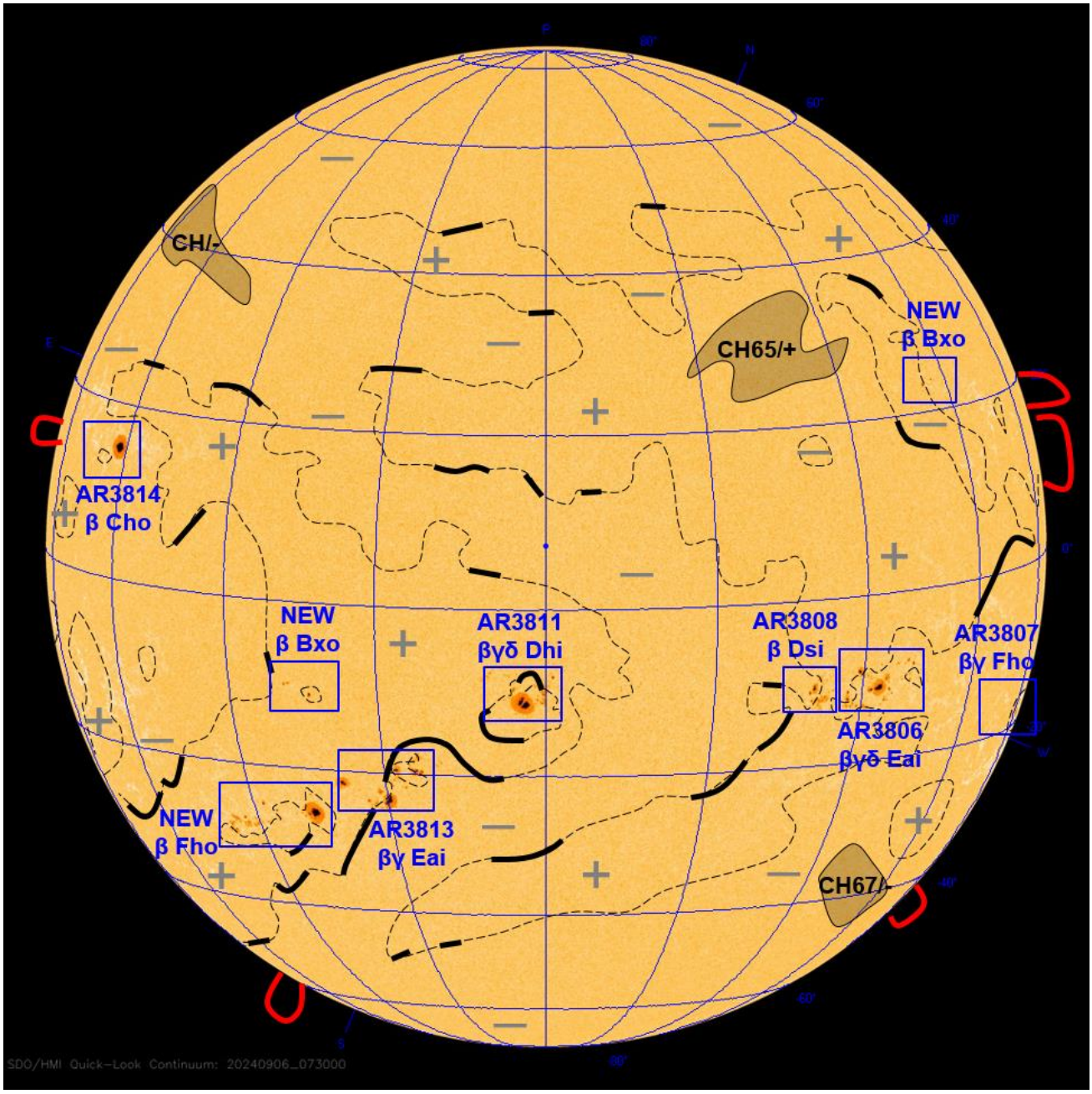
Figure 1. Solar Analysis Valid 06/0730 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

No Earth-directed CMEs feature in the current forecast.

Two coronal holes are located in the western disc. CH67/- is at mid-latitudes in the southern hemisphere and with Earth situated north of the solar equator it is not expected to become geo-effective. Larger CH65/+ in the northern hemisphere is considered much more likely to connect with Earth, beginning on Day 2 (07 Sep), but appears to have weakened in recent days. Therefore only slightly elevated wind speeds are considered likely at peak between Day 2 and 3 (07-08 Sep). This coronal hole on the previous rotation was in a slightly different location, and the solar wind was contaminated by CME arrivals, so persistence is not a particularly helpful guide here. However, the coronal hole being positive it is more likely to give a notable geomagnetic response at Earth at this time of year. MOSWOC Enlil is currently significantly overestimating the wind speed, modelling a broad and strong coronal hole which does not exist.

Geomagnetic activity is forecast to be largely Quiet, but expected to reach Unsettled to Active levels with a chance of peak G1/Minor Storm (Kp 5) conditions on Day 2 (07 Sep) owing to coronal hole fast wind interaction. Activity should subside to largely Quiet to Unsettled levels again by Day 3 (08 Sep), but with a chance of isolated Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	20	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections - Nil

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Radio Blackouts - X-Ray Flares:

There are currently nine sunspot regions on the visible disc with an unnumbered region west of AR3811 (Dhi/Beta-Gamma-Delta) now faded and a recently emerged, unnumbered bipolar group evident in the southeast. AR3806 (Eai/Beta-Gamma-Delta) in the southwest is one of two moderately complex regions on the disc, but has seen decay in many of the smaller spots surrounding its main mature spot. A very small delta region remains in the trailing portion of the group and lies in close proximity to AR3808 (Dsi/Beta), which evolves slowly and is magnetically connected to AR3806, increasing complexity. AR3807 (Fho/Beta-Gamma) is at the southwest limb, so the previous classification is maintained, but with inherent uncertainty over the current complexity of the region as it rotates out of view of SDO coronagraph imagery. AR3811 (Dhi/Beta-Gamma-Delta) evolves slowly but maintains a small delta configuration near centre-disc in the southern hemisphere. The largest group on the disc is AR3813 (Eai/Beta-Gamma) in the southeast. It also evolves slowly, but is close to developing a weak delta spot in the leading portion. Another region, unnumbered, follows closely behind AR3813, with some emergence of weak spots in the interior of the group. Remaining regions are smaller and either stable or with little change.

AR3807 may still present a risk of significant flares at GOES on Day 1 and 2 (06 and 07 Sep) before it rotates sufficiently over the western limb, onto the far side of the visible disc.

Activity has been High over the past 24hrs, with a solitary low-level M-class flare from AR3807 (M1.3 at 05/1325 UTC). Further M-class flares are likely, with a very slight chance of isolated X-class flares. The risk decreases very slightly by Day 3 (08 Sep) as AR3807 rotates well over the west limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	60	60
Very Active	R3 to R5 X Class	No	10	10	5	5

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Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18, is above background levels but slowly easing in response to the large eruption and associated M5.5 flare off the southeast limb on 01 Sep. However, it is considered unlikely to reach the S1/Minor Radiation Storm threshold at this time, in the absence of further notable flares.

There are several regions on the disc that could give an increase in proton flux, should they produce larger flares, including AR3806, AR3807 and AR3808. In the case of AR3807 the risk of proton response from any flares should significantly diminish by Day 3 (08 Sep) as it rotates further over the western limb.

Usually, AR3813 would be considered a low risk of exceeding S1/Minor Storm levels from its current location in the southeast quadrant. However, given that it has already produced a proton response at Earth at a time when it was closer to the east limb (on 01 Sep) this region is considered to pose the greatest risk of producing radiation storms, especially as it rotates westward into a more geo-effective location on the visible disc.

Overall, there is a slight but increasing chance of reaching the S1 threshold in the coming days, should there be any larger flares, predominantly from any of the aforementioned regions.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	20
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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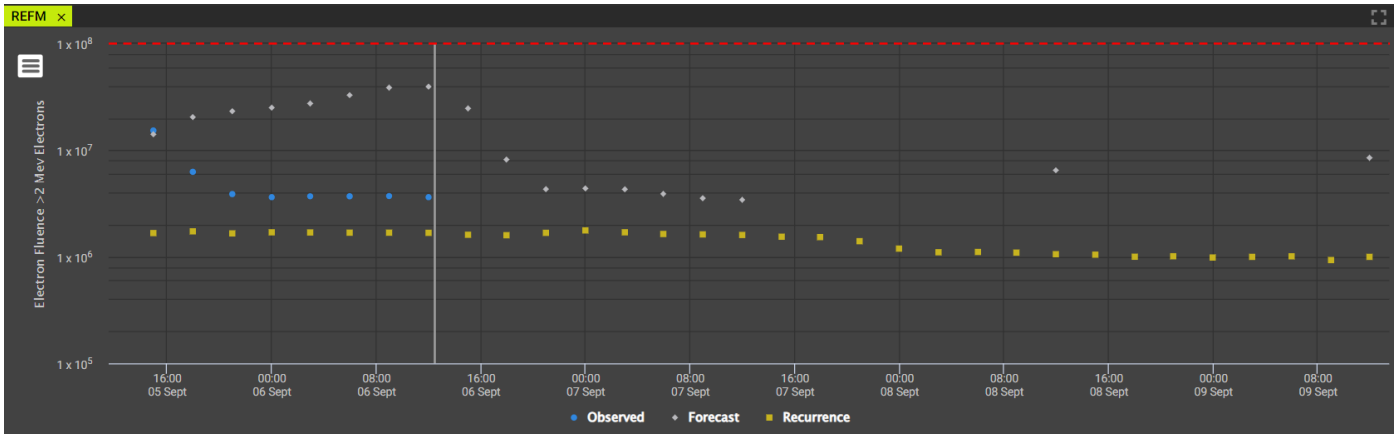
High Energy Electrons Event (≥ 2MeV):

High energy electron flux as observed by GOES-16 has been at background to moderate levels. Any weak HSS from CH65 may result in a slight increase in the electron flux, with levels becoming mainly moderate, with a slight chance of reaching high levels.

Overall, the 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold, although with perhaps with a rising trend later in the period after any HSS from CH65 starts to ease. Therefore, there is a slight chance of exceeding the Active threshold by the end of the period. MOSWOC REFM will not be taking into account the upcoming potential HSS, but the overal trend of the fluence remaining below Active is accepted.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 2. Latest MOSWOC REFM forecast



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